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PEARNE & GORDON LLP
1801 EAST 9TH STREET
SUITE 1200
CLEVELAND, OH 44114-3108

EXAMINER	
THANGAVELU, KANDASAMY	
ART UNIT	PAPER NUMBER
2123	5

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Please find below and/or attached an Office communication concerning this application or proceeding.

PTO-90C (Rev. 10/03)

Office Action Summary	Applicati n No.	Applicant(s)	
	09/612,582	NARAHARA ET AL.	
	Examiner	**Art Unit**	
	Kandasamy Thangavelu	2123	

-- The MAILING DATE of this c mmunication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *07 July 2000* .

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-28* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-28* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☒ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *07 July 2000* is/are: a)☐ accepted or b)☒ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☒ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____ .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: .

DETAILED ACTION

Introduction

1. Claims 1-28 of the application have been examined.

Foreign Priority

2. Acknowledgment is made of applicant's claim for foreign priority based on an application 11-196190 filed in Japan on July 9, 1999. Receipt is acknowledged of papers submitted under 35 U.S.C. 119(a)-(d), which papers have been placed of record in the file.

Drawings

3. The drawings are objected to; see a copy of Form PTO-948 for an explanation.

Specification

4. 35 U.S.C. 112, first paragraph, requires the specification to be written in "full, clear, concise, and exact terms." The specification is replete with terms which are not clear, concise and exact. The specification should be revised carefully in order to comply with 35 U.S.C. 112, first paragraph. Examples of some unclear, inexact or verbose terms used in the specification are:

Page 17, Lines 12-13, "but in sufficient in terms of EMI analysis" appears to be incorrect and it appears that it should be "but insufficient in terms of EMI analysis".

Page 17, Line 14, "summary of the invention" should be on a separate line and be centered, to clearly identify the subtitle.

Page 20, Lines 9-10, "calculating the instantaneous electric current for information for each event" appears to be incorrect and it appears that it should be "calculating the instantaneous electric current from information for each event".

Claim Objections

5. The following is a quotation of 37 C.F.R § 1.75 (d)(1):

> The claim or claims must conform to the invention as set forth in the remainder of the specification and terms and phrases in the claims must find clear support or antecedent basis in the description so that the meaning of the terms in the claims may be ascertainable by reference to the description.

6. Claims 3, 5, 6, 7, 8, 11, 15, 25 and 27 are objected to because of the following informalities:

Claim 3, Line 3, "whose height is calculated for information for each event" appears to be incorrect and it appears that it should be "whose height is calculated from information for each event". This informality occurs in most of the claims listed above.

Claim 8, Line 3, "and the resistance of a power" appears to be incorrect and it appears that it should be "and the resistance of a power line".

Claim 15, Line 7, "calculation step being taken as the height of the rectangular waveform and the area of the triangular waveform being equal to the amount of electric

current" appears to be incorrect and it appears that it should be "calculation step being taken as the height of the rectangular waveform and the area of the rectangular waveform being equal to the amount of electric current".

Appropriate corrections are required.

Claim Rejections - 35 USC § 112

7. The following is a quotation of the second paragraph of 35 U.S.C. § 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

8. Claims 1 and 28 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicants regard as the invention.

Claim 1, Line 13 states, "a modeling step of modeling the instantaneous electric current according to a predetermined rule". Then in Line 18, it again states, "the information being calculated through a modeling step". Thus it appears that there are two modeling steps. It is not clear if the applicants intended two modeling steps.

Claim 28, Line 10 states, "modeling means for modeling the instantaneous electric current according to a predetermined rule". Then in Lines 14-15, it again states, "the information being calculated through a modeling step". Thus it appears that there are two modeling steps. It is not clear if the applicants intended two modeling steps.

9. Claim 1 is rejected under 35 U.S.C. § 112, second paragraph, as being incomplete for omitting essential structural cooperative elements, such omission amounting to a gap between the necessary structural connections. See MPEP § 2172.01. The omitted structural cooperative relationships are:

electromagnetic interference analyzing step of analyzing the amount of electromagnetic interference arising in an LSI on the basis of a signal output from the FFT processing step.

Claim Rejections - 35 USC § 102

10. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (a) the invention was known or used by others in this country, or patented or described in a printed publication in this or a foreign country, before the invention thereof by the applicant for a patent.

11. Claims 1 and 28 are rejected under 35 U.S.C. 102(a) as being anticipated by **Hayashi et al. (HA)** ("EMI- Noise analysis under ASIC design environment", ACM 1999).

11.1 As per Claim 1, **HA** teaches an electromagnetic interference analysis method for analyzing the amount of electromagnetic interference arising in an LSI by means of performing a logic simulation (Page 16, CL1, Abstract; Page 18, CL2, Para 4); the method comprising:

an instantaneous current calculation step of calculating the amount of instantaneous electric current from event information, the information being produced when a change arises in

a signal and including the instance name of each cell in which the change has arisen, the name of the signal, a time at which the change has arisen, and transition information (Page 18, CL2, Para 4; Page 19, CL2, Para 2);

a modeling step of modeling the instantaneous electric current according to a predetermined rule (Page 18, CL2, Para 4 to Page 19, CL1, Para 2); and

an FFT processing step of subjecting to fast Fourier processing the information concerning a change in electric current, the information being calculated through a modeling step (CL3, L62-64; CL6, L46-52).

11.2 As per Claim 28, **HA** teaches an electromagnetic interference analysis system for analyzing the amount of electromagnetic interference arising in an LSI by means of performing a logic simulation (Page 16, CL1, Abstract; Page 18, CL2, Para 4); the system comprising:

a logic simulator (Page 18, CL2, Para 4);

computation means which is connected to the logic simulator and calculates the amount of instantaneous electric current from event information, the information being produced when a change arises in a signal and including the instance name of each cell in which the change has arisen, the name of the signal, a time at which the change has arisen, and transition information (Page 18, CL2, Para 4; Page 19, CL2, Para 2);

modeling means for modeling the instantaneous electric current according to a predetermined rule (Page 18, CL2, Para 4 to Page 19, CL1, Para 2); and

fast Fourier (FFT) conversion means for subjecting to fast Fourier processing the information concerning a change in electric current, the information being calculated through a

modeling step, thereby analyzing the amount of electromagnetic interference arising in an LSI on the basis of a signal output from the FFT conversion means (CL3, L62-64; CL6, L46-52).

Claim Rejections - 35 USC § 103

12. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains.

13. The factual inquiries set forth in *Graham* v. *John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

14. Claims 2-27 are rejected under 35 U.S.C. 103(a) as being unpatentable over **Hayashi et al. (HA)** ("EMI- Noise analysis under ASIC design environment", ACM 1999) in view of **Chen et al. (CH)** ("Power supply Noise analysis methodology for Deep-submicron VLSI chip design", ACM 1997).

14.1 As per Claim 2, **HA** teaches the method of claim 1. **HA** teaches that the FFT processing step includes a step of subjecting to FFT processing information concerning a change in current (Page 19, CL2, Para 3).

HA does not expressly teach that the modeling step includes an averaging step of averaging the instantaneous current over a certain discrete width; and that the FFT processing step includes a step of subjecting to FFT processing information concerning a change in current, the information being produced by the averaging step. **CH** teaches that the modeling step includes an averaging step of averaging the instantaneous current over a certain discrete width (Page 3, CL1, Para 3); and that the FFT processing step includes the information produced by the averaging step (Page 3, CL1, Para 3), as a triangular or trepeziodal current waveform, which is a simpler form of the piecewise linear current model can be derived from the total average current, the piecewise linear current models mimicing the waveforms of the actual circuits (Page 3, CL1, Para 3); and as per **HA**, using the power network and switching current waveform data, SPICE simulation can be performed and current/voltage waveforms obtained; by performing fast Fourier transformation for the current waveforms, EMI noise spectrum can be obtained (Page 19, CL2, Para 2 & 3). It would have been obvious to one of ordinary skill in the art at the time of Applicants' invention to modify the method of **HA** with the method of **CH** that included the modeling step including an averaging step of averaging the instantaneous current over a certain discrete width; and the FFT processing step including the information produced by the averaging step, as a triangular or trepeziodal current waveform, which would be a simpler form of the piecewise linear current model could be derived from the total average current, the piecewise linear current models mimicing the waveforms of the actual circuits; that would allow obtaining

the switching current waveform as a function of input slew and output load; using the power network and switching current waveform data, SPICE simulation could be performed and current/voltage waveforms obtained; by performing fast Fourier transformation for the current waveforms, EMI noise spectrum could be obtained.

14.2 As per Claim 3, **HA** teaches the method of claim 1. **HA** teaches that the FFT processing step includes a step of subjecting to FFT processing information concerning a change in current, (Page 19, CL2, Para 3).

HA does not expressly teach that the modeling step includes a rectangular waveform modeling step of modeling the instantaneous current as a rectangular waveform whose height is calculated for information for each event such that the area of the rectangular waveform becomes equal to the amount of electric current of each event; and that the FFT processing step includes a step of subjecting to FFT processing information concerning a change in current, the information being calculated in the rectangular waveform modeling step. **CH** teaches that the modeling step includes a rectangular waveform modeling step of modeling the instantaneous current as a rectangular waveform whose height is calculated for information for each event such that the area of the rectangular waveform becomes equal to the amount of electric current of each event; the rectangular waveform is special case of the general trepezoidal waveform if the rise and fall times are zero (Page 3, CL1, Para 3 to Page 3, CL2, Para 2; Fig 5); and that the FFT processing step includes the information calculated in the rectangular waveform modeling step (Page 3, CL1, Para 3 to Page 3, CL2, Para 2; Fig 5), because as per **HA**, a trepeziodal or rectangular current waveform is a simpler form of the piecewise linear current model which reduces the

amount of data required to be saved and the interpolation is simple (Page 19, CL1, Para 1); and as per **HA**, using the power network and switching current waveform data, SPICE simulation can be performed and current/voltage waveforms obtained; by performing fast Fourier transformation for the current waveforms, EMI noise spectrum can be obtained (Page 19, CL2, Para 2 & 3). It would have been obvious to one of ordinary skill in the art at the time of Applicants' invention to modify the method of **HA** with the method of **CH** that included the modeling step including a rectangular waveform modeling step of modeling the instantaneous current as a rectangular waveform whose height was calculated for information for each event such that the area of the rectangular waveform became equal to the amount of electric current of each event; and the FFT processing step including the information calculated in the rectangular waveform modeling step, as a trepeziodal or rectangular current waveform would be a simpler form of the piecewise linear current model which would reduce the amount of data required to be saved and the interpolation would be simple; that would allow obtaining the switching current waveform as a function of input slew and output load; using the power network and switching current waveform data, SPICE simulation could be performed and current/voltage waveforms obtained; by performing fast Fourier transformation for the current waveforms, EMI noise spectrum could be obtained.

14.3 As per Claim 4, **HA** teaches the method of claim 1. **HA** teaches that the FFT processing step includes a step of subjecting to FFT processing information concerning a change in current (Page 19, CL2, Para 3).

HA does not expressly teach that the modeling step includes a geometrically-similar rectangular waveform modeling step of modeling the instantaneous current as a geometrically-similar rectangular waveform whose height is calculated for information for each event such that the area of the rectangular waveform becomes equal to the amount of electric current of each event; and that the FFT processing step includes a step of subjecting to FFT processing information concerning a change in current, the information being calculated in the geometrically-similar rectangular waveform modeling step. **CH** teaches that the modeling step includes a geometrically-similar rectangular waveform modeling step of modeling the instantaneous current as a geometrically-similar rectangular waveform whose height is calculated for information for each event such that the area of the rectangular waveform becomes equal to the amount of electric current of each event; the rectangular waveform is special case of the general trepezoidal waveform if the rise and fall times are zero (Page 3, CL1, Para 3 to Page 3, CL2, Para 2; Fig 5); and that the FFT processing step includes the information calculated in the geometrically-similar rectangular waveform modeling step (Page 3, CL1, Para 3 to Page 3, CL2, Para 2; Fig 5), because as per **HA**, a trepeziodal or rectangular current waveform is a simpler form of the piecewise linear current model which reduces the amount of data required to be saved and the interpolation is simple (Page 19, CL1, Para 1); and as per **HA**, using the power network and switching current waveform data, SPICE simulation can be performed and current/voltage waveforms obtained; by performing fast Fourier transformation for the current waveforms, EMI noise spectrum can be obtained (Page 19, CL2, Para 2 & 3). It would have been obvious to one of ordinary skill in the art at the time of Applicants' invention to modify the method of **HA** with the method of **CH** that included the modeling step including a

geometrically-similar rectangular waveform modeling step of modeling the instantaneous current as a geometrically-similar rectangular waveform whose height was calculated for information for each event such that the area of the rectangular waveform became equal to the amount of electric current of each event; and the FFT processing step including the information calculated in the geometrically-similar rectangular waveform modeling step, as a trepeziodal or rectangular current waveform would be a simpler form of the piecewise linear current model which would reduce the amount of data required to be saved and the interpolation would be simple; that would allow obtaining the switching current waveform as a function of input slew and output load; using the power network and switching current waveform data, SPICE simulation could be performed and current/voltage waveforms obtained; by performing fast Fourier transformation for the current waveforms, EMI noise spectrum could be obtained.

14.4 As per Claim 5, **HA** teaches the method of claim 1. **HA** teaches that the modeling step includes modeling the instantaneous current as a rectangular waveform through use of a table representing the relationship between the width and height of a rectangular waveform (Page 18, CL2, Para 4). **HA** teaches subjecting to FFT processing the information concerning a change in electric current (Page 19, CL2, Para 3)

HA does not expressly teach that the modeling step includes a rectangular waveform modeling step of calculating the instantaneous electric current for each event information, and a step of modeling the instantaneous current as a rectangular waveform through use of the amount of electric current; and that subjecting to FFT processing the information concerning a change in electric current calculated in the rectangular waveform modeling step. **CH** teaches that the

modeling step includes a rectangular waveform modeling step of calculating the instantaneous electric current for each event information, and a step of modeling the instantaneous current as a rectangular waveform through use of the amount of electric current; the rectangular waveform is special case of the general trepezoidal waveform if the rise and fall times are zero (Page 3, CL1, Para 3 to Page 3, CL2, Para 2; Fig 5); and that subjecting to FFT processing the information concerning a change in electric current calculated in the rectangular waveform modeling step (Page 3, CL1, Para 3 to Page 3, CL2, Para 2; Fig 5), because as per **HA**, a trepeziodal or rectangular current waveform is a simpler form of the piecewise linear current model which reduces the amount of data required to be saved and the interpolation is simple (Page 19, CL1, Para 1); and as per **HA**, using the power network and switching current waveform data, SPICE simulation can be performed and current/voltage waveforms obtained; by performing fast Fourier transformation for the current waveforms, EMI noise spectrum can be obtained (Page 19, CL2, Para 2 & 3). It would have been obvious to one of ordinary skill in the art at the time of Applicants' invention to modify the method of **HA** with the method of **CH** that included the modeling step including a rectangular waveform modeling step of calculating the instantaneous electric current for each event information, and a step of modeling the instantaneous current as a rectangular waveform through use of the amount of electric current; and subjecting to FFT processing the information concerning a change in electric current calculated in the rectangular waveform modeling step, as a trepeziodal or rectangular current waveform would be a simpler form of the piecewise linear current model which would reduce the amount of data required to be saved and the interpolation would be simple; that would allow obtaining the switching current waveform as a function of input slew and output load; using the power network and switching

current waveform data, SPICE simulation could be performed and current/voltage waveforms obtained; by performing fast Fourier transformation for the current waveforms, EMI noise spectrum could be obtained.

14.5 As per Claim 6, **HA** teaches the method of claim 1. **HA** teaches modeling the instantaneous current as a rectangular waveform through use of a slew in input waveform and a table representing the relationship between the width and height of a rectangular waveform (Page 18, CL2, Para 4). **HA** teaches subjecting to FFT processing the information concerning a change in electric current (Page 19, CL2, Para 3)

HA does not expressly teach that the modeling step includes a step of calculating the instantaneous electric current for information for each event, and a rectangular waveform modeling step of modeling the instantaneous current as a rectangular waveform; and subjecting to FFT processing the information concerning a change in electric current calculated in the rectangular waveform modeling step. **CH** teaches that the modeling step includes a step of calculating the instantaneous electric current for information for each event, and a rectangular waveform modeling step of modeling the instantaneous current as a rectangular waveform; the rectangular waveform is special case of the general trepezoidal waveform if the rise and fall times are zero (Page 3, CL1, Para 3 to Page 3, CL2, Para 2; Fig 5); and subjecting to FFT processing the information concerning a change in electric current calculated in the rectangular waveform modeling step (Page 3, CL1, Para 3 to Page 3, CL2, Para 2; Fig 5), because as per **HA,** a trepeziodal or rectangular current waveform is a simpler form of the piecewise linear current model which reduces the amount of data required to be saved and the interpolation is

simple (Page 19, CL1, Para 1); and as per **HA**, using the power network and switching current waveform data, SPICE simulation can be performed and current/voltage waveforms obtained; by performing fast Fourier transformation for the current waveforms, EMI noise spectrum can be obtained (Page 19, CL2, Para 2 & 3). It would have been obvious to one of ordinary skill in the art at the time of Applicants' invention to modify the method of **HA** with the method of **CH** that included the modeling step including a step of calculating the instantaneous electric current for information for each event, and a rectangular waveform modeling step of modeling the instantaneous current as a rectangular waveform; and subjecting to FFT processing the information concerning a change in electric current calculated in the rectangular waveform modeling step, as a trepeziodal or rectangular current waveform would be a simpler form of the piecewise linear current model which would reduce the amount of data required to be saved and the interpolation would be simple; that would allow obtaining the switching current waveform as a function of input slew and output load; using the power network and switching current waveform data, SPICE simulation could be performed and current/voltage waveforms obtained; by performing fast Fourier transformation for the current waveforms, EMI noise spectrum could be obtained.

14.6 As per Claim 7, **HA** teaches the method of claim 1. **HA** teaches that the modeling step includes a step of calculating the instantaneous electric current for information for each event (Page 18, CL2, Para 4). **HA** teaches modeling the instantaneous current as a rectangular waveform through use of an output load capacitance and a table representing the relationship between the width and height of a rectangular waveform (Page 17, CL2, Para 1 to Page 18, CL1,

Para 3). **HA** teaches subjecting to FFT processing the information concerning a change in electric current (Page 19, CL2, Para 3)

HA does not expressly teach that the modeling step includes a rectangular waveform modeling step of modeling the instantaneous current as a rectangular waveform; and subjecting to FFT processing the information concerning a change in electric current calculated in the rectangular waveform modeling step. **CH** teaches that the modeling step includes a rectangular waveform modeling step of modeling the instantaneous current as a rectangular waveform; the rectangular waveform is special case of the general trepezoidal waveform if the rise and fall times are zero (Page 3, CL1, Para 3 to Page 3, CL2, Para 2; Fig 5); and subjecting to FFT processing the information concerning a change in electric current calculated in the rectangular waveform modeling step (Page 3, CL1, Para 3 to Page 3, CL2, Para 2; Fig 5), because as per **HA**, a trepeziodal or rectangular current waveform is a simpler form of the piecewise linear current model which reduces the amount of data required to be saved and the interpolation is simple (Page 19, CL1, Para 1); and as per **HA**, using the power network and switching current waveform data, SPICE simulation can be performed and current/voltage waveforms obtained; by performing fast Fourier transformation for the current waveforms, EMI noise spectrum can be obtained (Page 19, CL2, Para 2 & 3). It would have been obvious to one of ordinary skill in the art at the time of Applicants' invention to modify the method of **HA** with the method of **CH** that included the modeling step including a rectangular waveform modeling step of modeling the instantaneous current as a rectangular waveform; and subjecting to FFT processing the information concerning a change in electric current calculated in the rectangular waveform modeling step, as a trepeziodal or rectangular current waveform would be a simpler form of the

piecewise linear current model which would reduce the amount of data required to be saved and the interpolation would be simple; that would allow obtaining the switching current waveform as a function of input slew and output load; using the power network and switching current waveform data, SPICE simulation could be performed and current/voltage waveforms obtained; by performing fast Fourier transformation for the current waveforms, EMI noise spectrum could be obtained.

14.7 As per Claim 8, **HA** teaches the method of claim 1. **HA** teaches that the modeling step includes a step of calculating a drop in voltage from the amount of electric current flowing in each cell and correcting the amount of instantaneous electric current of each cell for each event, on the basis of the relationship between the drop in voltage and the amount of instantaneous electric current (Page 19, CL1, Para 2).

HA does not expressly teach that the modeling step includes a step of calculating a drop in voltage from the resistance of a power. **CH** teaches that the modeling step includes a step of calculating a drop in voltage from the resistance of a power (Page 1, CL1, Para 2), as the analysis of the power supply noise should include the IR drop, to keep the power supply within specification, provide signal integrity and reduce the EMI radiation noise (Page 1, CL1, Para 2). It would have been obvious to one of ordinary skill in the art at the time of Applicants' invention to modify the method of **HA** with the method of **CH** that included the modeling step including a step of calculating a drop in voltage from the resistance of a power, as the analysis of the power supply noise should include the IR drop, to keep the power supply within specification, provide signal integrity and reduce the EMI radiation noise.

14.8 As per Claim 9, **HA** teaches the method of claim 1. **HA** teaches that the modeling step includes a step of calculating a drop in voltage from the amount of electric current flowing in each cell and correcting the amount of instantaneous electric current of each cell for each event, on the basis of the relationship between the drop in voltage and the amount of instantaneous electric current (Page 19, CL1, Para 2).

HA does not expressly teach that the modeling step includes a step of calculating a drop in voltage from the resistance of a power line. **CH** teaches that the modeling step includes a step of calculating a drop in voltage from the resistance of a power line (Page 1, CL1, Para 2), as the analysis of the power supply noise should include the IR drop, to keep the power supply within specification, provide signal integrity and reduce the EMI radiation noise (Page 1, CL1, Para 2). It would have been obvious to one of ordinary skill in the art at the time of Applicants' invention to modify the method of **HA** with the method of **CH** that included the modeling step including a step of calculating a drop in voltage from the resistance of a power line, as the analysis of the power supply noise should include the IR drop, to keep the power supply within specification, provide signal integrity and reduce the EMI radiation noise.

HA does not expressly teach that the modeling step includes a step of calculating a drop in voltage from the capacitance of an on-chip capacitor. **CH** teaches that the modeling step includes a step of calculating a drop in voltage from the capacitance of an on-chip capacitor (Page 2, CL2, Para 3), as the on-chip power supply voltage drop analysis requires model of the resistance, capacitance and inductance of each power bus segment (Page 2, CL2, Para 3). It would have been obvious to one of ordinary skill in the art at the time of Applicants' invention to

modify the method of **HA** with the method of **CH** that included the modeling step including a step of calculating a drop in voltage from the capacitance of an on-chip capacitor, as the on-chip power supply voltage drop analysis would require model of the resistance, capacitance and inductance of each power bus segment.

14.9 As per Claim 10, **HA** teaches the method of claim 1. **HA** teaches that the modeling step includes accurately calculating a drop in voltage, and a correction step of correcting the amount of instantaneous electric current of each cell for each event, on the basis of the relationship between the drop in voltage and the amount of instantaneous electric current (Page 19, CL1, Para 2).

HA does not expressly teach that the modeling step includes a step of transiently analyzing a power RC of each cell and a cell power source. **CH** teaches that the modeling step includes a step of transiently analyzing a power RC of each cell and a cell power source (Page 2, CL2, Para 3), as the on-chip power supply voltage drop analysis requires model of the resistance, capacitance and inductance of each power bus segment (Page 2, CL2, Para 3). It would have been obvious to one of ordinary skill in the art at the time of Applicants' invention to modify the method of **HA** with the method of **CH** that included the modeling step including a step of transiently analyzing a power RC of each cell and a cell power source, as the on-chip power supply voltage drop analysis would require model of the resistance, capacitance and inductance of each power bus segment.

14.10 As per Claim 11, **HA** teaches the method of claim 1. **HA** teaches that the modeling step includes a triangular waveform modeling step of modeling the instantaneous current as a triangular waveform which has a given width and whose height is calculated for each event information such that the amount of instantaneous electric current becomes equal to the area of the triangular waveform (Page 19, CL1, Para 1; Fig 10). **HA** teaches that the FFT processing step includes a step of subjecting to FFT processing information concerning a change in current, the information being calculated in the triangular waveform modeling step (Page 19, CL2, Para 3).

14.11 As per Claim 12, **HA** teaches the method of claim 1. **HA** teaches that the FFT processing step includes a step of subjecting to FFT processing information concerning a change in current (Page 19, CL2, Para 3)

HA does not expressly teach that the modeling step includes a multi-order-function waveform modeling step of modeling the instantaneous current as a multi-order-function waveform; and that the FFT processing step includes a step of subjecting to FFT processing information concerning a change in current, the information being calculated in the multi-order-function waveform modeling step. **CH** teaches that the modeling step includes a multi-order-function waveform modeling step of modeling the instantaneous current as a multi-order-function waveform (Page 3, CL1, Para 3 to Page 3, CL2, Para 2; Fig 5); and that the FFT processing step includes the information calculated in the multi-order-function waveform modeling step (Page 3, CL1, Para 3 to Page 3, CL2, Para 2; Fig 5), because as per **HA**, a

multi-order-function waveform is a simpler form of the piecewise linear current model which reduces the amount of data required to be saved and the interpolation is simple (Page 19, CL1, Para 1); and as per **HA**, using the power network and switching current waveform data, SPICE simulation can be performed and current/voltage waveforms obtained; by performing fast Fourier transformation for the current waveforms, EMI noise spectrum can be obtained (Page 19, CL2, Para 2 & 3). It would have been obvious to one of ordinary skill in the art at the time of Applicants' invention to modify the method of **HA** with the method of **CH** that included the modeling step including a multi-order-function waveform modeling step of modeling the instantaneous current as a multi-order-function waveform; and that the FFT processing step includes the information calculated in the multi-order-function waveform modeling step, as a multi-order-function waveform would be a simpler form of the piecewise linear current model which would reduce the amount of data required to be saved and the interpolation would be simple; that would allow obtaining the switching current waveform as a function of input slew and output load; using the power network and switching current waveform data, SPICE simulation could be performed and current/voltage waveforms obtained; by performing fast Fourier transformation for the current waveforms, EMI noise spectrum could be obtained.

14.12 As per Claim 14, **HA** teach the method of claim 1. **HA** does not expressly teach that the modeling step includes a step of modeling the amount of instantaneous electric current while separating the same into a short circuit electric current component and a charge current component. **CH** teaches that the modeling step includes a step of modeling the amount of instantaneous electric current while separating the same into a short circuit electric current

component and a charge current component (Page 1, CL1, Para 2; Page 2, CL2, Para 3), as the on-chip power supply voltage drop analysis requires model of the resistance, capacitance and inductance of each power bus segment (Page 2, CL2, Para 3). It would have been obvious to one of ordinary skill in the art at the time of Applicants' invention to modify the method of **HA** with the method of **CH** that included the modeling step including a step of modeling the amount of instantaneous electric current while separating the same into a short circuit electric current component and a charge current component, as the on-chip power supply voltage drop analysis would require model of the resistance, capacitance and inductance of each power bus segment.

14.13 As per Claim 15, **HA** teach the method of claim 1. **HA** teaches that the modeling step includes a calculation step of calculating the height of a rectangular waveform from a library in which peak currents of cells are characterized according to the type of cell, the peak current calculated in the calculation step being taken as the height of the rectangular waveform and the area of the triangular waveform being equal to the amount of electric current of each event (Page 18, CL2, Para 4). **HA** teaches that the FFT processing step includes a step of subjecting to FFT processing information concerning a change in current, the information being calculated in the rectangular waveform modeling step (Page 19, CL2, Para 3).

HA does not expressly teach that the modeling step includes a rectangular waveform modeling step of modeling the amount of instantaneous electric current as a rectangular waveform; and that the FFT processing step includes a step of subjecting to FFT processing information concerning a change in current, the information being calculated in the rectangular waveform modeling step. **CH** teaches that the modeling step includes a rectangular waveform

modeling step of modeling the amount of instantaneous electric current as a rectangular waveform; the rectangular waveform is special case of the general trepezoidal waveform if the rise and fall times are zero (Page 3, CL1, Para 3 to Page 3, CL2, Para 2; Fig 5); and that the FFT processing step includes the information calculated in the rectangular waveform modeling step (Page 3, CL1, Para 3 to Page 3, CL2, Para 2; Fig 5), because as per **HA**, a trepeziodal or rectangular current waveform is a simpler form of the piecewise linear current model which reduces the amount of data required to be saved and the interpolation is simple (Page 19, CL1, Para 1); and as per **HA**, using the power network and switching current waveform data, SPICE simulation can be performed and current/voltage waveforms obtained; by performing fast Fourier transformation for the current waveforms, EMI noise spectrum can be obtained (Page 19, CL2, Para 2 & 3). It would have been obvious to one of ordinary skill in the art at the time of Applicants' invention to modify the method of **HA** with the method of **CH** that included the modeling step including a rectangular waveform modeling step of modeling the amount of instantaneous electric current as a rectangular waveform and the FFT processing step including the information calculated in the rectangular waveform modeling step, as a trepeziodal or rectangular current waveform would be a simpler form of the piecewise linear current model which would reduce the amount of data required to be saved and the interpolation would be simple; that would allow obtaining the switching current waveform as a function of input slew and output load; using the power network and switching current waveform data, SPICE simulation could be performed and current/voltage waveforms obtained; by performing fast Fourier transformation for the current waveforms, EMI noise spectrum could be obtained.

14.14 As per Claim 16, **HA** and **CH** teach the method of claim 15. **HA** also teaches that the calculation step includes a step of calculating a peak current for each cell from information concerning a slew in the cell, by reference to a library in which the relationship between a slew in input waveform and a peak current is characterized in the form of a table according to the type of cell (Page 18, CL2, Para 4).

14.15 As per Claim 17, **HA** and **CH** teach the method of claim 15. **HA** also teaches that the calculation step includes a step of calculating a peak current for each cell from information concerning a load capacitance of a cell, by reference to a library in which the relationship between a load capacitance and a peak current is characterized in the form of a table according to the type of cell (Page 17, CL2, Para 1 to Page 18, CL1, Para 3).

14.16 As per Claim 18, **HA** and **CH** teach the method of claim 15. **HA** teaches that the calculation step includes a step of setting a plurality of peak currents for a composite cell and calculating the heights of a plurality of rectangular waveforms through use of a characterized library (Page 18, CL2, Para 4).

HA does not expressly teach that the rectangular waveform modeling step corresponds to a step of modeling the amount of electric current into a plurality of rectangular waveforms. **CH** teaches that the rectangular waveform modeling step corresponds to a step of modeling the amount of electric current into a plurality of rectangular waveforms; the rectangular waveform is special case of the general trepezoidal waveform if the rise and fall times are zero (Page 3, CL1, Para 3 to Page 3, CL2, Para 2; Fig 5), because as per **HA**, a trepeziodal or rectangular current

waveform is a simpler form of the piecewise linear current model which reduces the amount of data required to be saved and the interpolation is simple (Page 19, CL1, Para 1); and as per **HA**, using the power network and switching current waveform data, SPICE simulation can be performed and current/voltage waveforms obtained; by performing fast Fourier transformation for the current waveforms, EMI noise spectrum can be obtained (Page 19, CL2, Para 2 & 3). It would have been obvious to one of ordinary skill in the art at the time of Applicants' invention to modify the method of **HA** with the method of **CH** that included the rectangular waveform modeling step corresponding to a step of modeling the amount of electric current into a plurality of rectangular waveforms, as a trepeziodal or rectangular current waveform would be a simpler form of the piecewise linear current model which would reduce the amount of data required to be saved and the interpolation would be simple; that would allow obtaining the switching current waveform as a function of input slew and output load; using the power network and switching current waveform data, SPICE simulation could be performed and current/voltage waveforms obtained; by performing fast Fourier transformation for the current waveforms, EMI noise spectrum could be obtained.

14.17 As per Claim 19, **HA** and **CH** teach the method of claim 15. **HA** also teaches that the calculation step includes a step of setting a plurality of peak currents for each of the rise and fall of a flip-flop (FF) cell and calculating the heights of a plurality of rectangular waveforms through use of a characterized library.

HA does not expressly teach that the rectangular waveform modeling step corresponds to a step of modeling the amount of electric current into a plurality of rectangular waveforms. **CH**

teaches that the rectangular waveform modeling step corresponds to a step of modeling the amount of electric current into a plurality of rectangular waveforms; the rectangular waveform is special case of the general trepezoidal waveform if the rise and fall times are zero (Page 3, CL1, Para 3 to Page 3, CL2, Para 2; Fig 5), because as per **HA**, a trepeziodal or rectangular current waveform is a simpler form of the piecewise linear current model which reduces the amount of data required to be saved and the interpolation is simple (Page 19, CL1, Para 1); and as per **HA**, using the power network and switching current waveform data, SPICE simulation can be performed and current/voltage waveforms obtained; by performing fast Fourier transformation for the current waveforms, EMI noise spectrum can be obtained (Page 19, CL2, Para 2 & 3). It would have been obvious to one of ordinary skill in the art at the time of Applicants' invention to modify the method of **HA** with the method of **CH** that included the rectangular waveform modeling step corresponding to a step of modeling the amount of electric current into a plurality of rectangular waveforms, as a trepeziodal or rectangular current waveform would be a simpler form of the piecewise linear current model which would reduce the amount of data required to be saved and the interpolation would be simple; that would allow obtaining the switching current waveform as a function of input slew and output load; using the power network and switching current waveform data, SPICE simulation could be performed and current/voltage waveforms obtained; by performing fast Fourier transformation for the current waveforms, EMI noise spectrum could be obtained.

14.18 As per Claim 20, **HA** and **CH** teach the method of claim 15. **HA** teaches that the calculation step includes a step of calculating the height of a rectangular waveform through use

of a library in which peak currents are characterized in consideration of the state of an input signal (Page 18, CL2, Para 4).

14.19 As per Claim 21, **HA** and **CH** teach the method of claim 15. **HA** teaches that the modeling step includes a step of calculating a drop in voltage from the amount of electric current determined according to the type of cell and a correction step of characterizing, for each cell, the relationship between a drop in voltage and the amount of instantaneous electric current in the form of a table, to thereby correct the amount of instantaneous electric current for each event of the cell (Page 19, CL1, Para 2).

HA does not expressly teach that the modeling step includes a step of calculating a drop in voltage from the resistance of a power line. **CH** teaches that the modeling step includes a step of calculating a drop in voltage from the resistance of a power line (Page 1, CL1, Para 2), as the analysis of the power supply noise should include the IR drop, to keep the power supply within specification, provide signal integrity and reduce the EMI radiation noise (Page 1, CL1, Para 2). It would have been obvious to one of ordinary skill in the art at the time of Applicants' invention to modify the method of **HA** with the method of **CH** that included the modeling step including a step of calculating a drop in voltage from the resistance of a power line , as the analysis of the power supply noise should include the IR drop, to keep the power supply within specification, provide signal integrity and reduce the EMI radiation noise.

14.20 As per Claim 22, **HA** and **CH** teach the method of claim 15. **HA** teaches that the modeling step includes a step of calculating a drop in voltage from the amount of electric current

determined according to the type of cell and a correction step of characterizing, for each cell, the relationship between a drop in voltage and the amount of instantaneous electric current in the form of a table, to thereby correct the amount of instantaneous electric current for each event of the cell (Page 19, CL1, Para 2).

HA does not expressly teach that the modeling step includes a step of calculating a drop in voltage from the resistance of a power line. **CH** teaches that the modeling step includes a step of calculating a drop in voltage from the resistance of a power line (Page 1, CL1, Para 2), as the analysis of the power supply noise should include the IR drop, to keep the power supply within specification, provide signal integrity and reduce the EMI radiation noise (Page 1, CL1, Para 2). It would have been obvious to one of ordinary skill in the art at the time of Applicants' invention to modify the method of **HA** with the method of **CH** that included the modeling step including a step of calculating a drop in voltage from the resistance of a power line, as the analysis of the power supply noise should include the IR drop, to keep the power supply within specification, provide signal integrity and reduce the EMI radiation noise.

HA does not expressly teach that the modeling step includes a step of calculating a drop in voltage from the capacitance of an on-chip capacitor. **CH** teaches that the modeling step includes a step of calculating a drop in voltage from the capacitance of an on-chip capacitor (Page 2, CL2, Para 3), as the on-chip power supply voltage drop analysis requires model of the resistance, capacitance and inductance of each power bus segment (Page 2, CL2, Para 3). It would have been obvious to one of ordinary skill in the art at the time of Applicants' invention to modify the method of **HA** with the method of **CH** that included the modeling step including a step of calculating a drop in voltage from the capacitance of an on-chip capacitor, as the on-chip

power supply voltage drop analysis would require model of the resistance, capacitance and inductance of each power bus segment.

14.21 As per Claim 23, **HA** and **CH** teach the method of claim 10. **HA** teaches that the correction step includes a step of iterating several times calculation of a drop in voltage and correction of a current waveform (Page 19, CL1, Para 3).

14.22 As per Claim 24, **HA** and **CH** teach the method of claim 15. **HA** does not expressly teach that the calculation step includes a step of modeling the amount of instantaneous electric current while separating the same into a short circuit electric current component and a charge current component. **CH** teaches that the calculation step includes a step of modeling the amount of instantaneous electric current while separating the same into a short circuit electric current component and a charge current component (Page 1, CL1, Para 2; Page 2, CL2, Para 3), as the on-chip power supply voltage drop analysis requires model of the resistance, capacitance and inductance of each power bus segment (Page 2, CL2, Para 3). It would have been obvious to one of ordinary skill in the art at the time of Applicants' invention to modify the method of **HA** with the method of **CH** that included the calculation step including a step of modeling the amount of instantaneous electric current while separating the same into a short circuit electric current component and a charge current component, as the on-chip power supply voltage drop analysis would require model of the resistance, capacitance and inductance of each power bus segment.

14.23 As per Claim 25, **HA** teach the method of claim 1. **HA** teaches that the modeling step includes a triangular waveform modeling step of modeling the instantaneous current as a triangular waveform whose width is calculated for each event information such that the area of the triangular waveform becomes equal to the amount of electric current of each event, the height of the triangular waveform being calculated on the basis of the width (Page 19, CL1, Para 1; Fig 10). **HA** teaches that the modeling step includes a triangular waveform modeling step of modeling for each event information in consideration of slew information (i.e., an output slew) for an output terminal of a cell (Page 18, CL2, Para 4). **HA** teaches that the FFT processing step includes a step of subjecting to FFT processing information concerning a change in current, the information being calculated in the triangular waveform modeling step (Page 19, CL2, Para 3).

14.24 As per Claim 26, **HA** teach the method of claim 1. **HA** teaches that the modeling step includes a triangular height calculation step of calculating the height of a triangular waveform such that the area of the triangular waveform becomes equal to the amount of electric current of each event, by means of multiplying the amount of instantaneous electric current by a coefficient corresponding to the state of an event of a cell, in consideration of whether the event of the cell is in a rising state or a falling state (Page 19, CL1, Para 1; Fig 10).

14.25 As per Claim 27, **HA** teach the method of claim 1. **HA** teaches that the modeling step includes a step of calculating the amount of instantaneous electric current for each event information in the case of a composite cell and a triangular waveform modeling step of modeling the amount of instantaneous electric current as a plurality of triangular waveforms which are

equal in number to the stages provided in the composite cell (Page 19, CL1, Para 1; Fig 10). **HA** teaches that the modeling step includes modeling the amount of instantaneous electric current through the use of a table representing the relationship between the width and height of a triangular waveform (Page 18, CL2, Para 4). **HA** teaches subjecting to FFT processing the information concerning a change in electric current calculated in the triangular waveform modeling step (Page 19, CL2, Para 3).

15. Claim 13 is rejected under 35 U.S.C. 103(a) as being unpatentable over **Hayashi et al. (HA)** ("EMI- Noise analysis under ASIC design environment", ACM 1999) in view of **Chen et al. (CH)** ("Power supply Noise analysis methodology for Deep-submicron VLSI chip design", ACM 1997), and further in view of McIntosh et al. (**MC**) (U.S. Patent 6,151,967).

15.1 As per Claim 13, **HA** teaches the method of claim 1. **HA** teaches that the FFT processing step includes a step of subjecting to FFT processing information concerning a change in current (Page 19, CL2, Para 3)

HA does not expressly teach that the modeling step includes an exponential function waveform modeling step of modeling the instantaneous current as an exponential-function waveform; and that the FFT processing step includes a step of subjecting to FFT processing information concerning a change in current, the information being calculated in the exponential-function waveform modeling step. **MC** teaches that the modeling step includes an exponential function waveform modeling step of modeling the instantaneous current as an exponential-function waveform (CL15, L54-64); and that the FFT processing step includes the

information calculated in the exponential-function waveform modeling step (CL15, L54-64), as the circuits include resistors and capacitors; the resistors discharge the voltages across the capacitor to zero during the voltage drop; the waveform of the voltage is exponential, resulting in exponential waveform of the current (CL15, L54-64). It would have been obvious to one of ordinary skill in the art at the time of Applicants' invention to modify the method of **HA** with the method of **CH** that included the modeling step including an exponential function waveform modeling step of modeling the instantaneous current as an exponential-function waveform; and that the FFT processing step including the information calculated in the exponential-function waveform modeling step, as the circuits would include resistors and capacitors; the resistors would discharge the voltages across the capacitor to zero during the voltage drop; the waveform of the voltage would be exponential, resulting in exponential waveform of the current.

Conclusion

16. The prior art made of record and not relied upon is considered pertinent to the Applicants' disclosure.

The following patents and papers are cited to further show the state of the art at the time of Applicants' invention with respect to EMI analysis by logic simulation:

1. Bonitz, "Electrical analysis of integrated circuits", U.S. Patent 6,237,126.
2. Kobayashi et al., "Method and apparatus for searching electromagnetic disturbing source ...", U.S. Patent 6,154,710.

3. Mortensen, "Integrated circuit having reduced electromagnetic emissions ...", U.S. Patent 5,317,207.

17. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Dr. Kandasamy Thangavelu whose telephone number is 703-305-0043. The examiner can normally be reached on Monday through Friday from 8:00 AM to 5:30 PM.

If attempts to reach examiner by telephone are unsuccessful, the examiner's supervisor, Kevin Teska, can be reached on (703) 305-9704. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-305-9600.

K. Thangavelu
Art Unit 2123
October 31, 2003

KEVIN J. TESKA
SUPERVISORY
PATENT EX